**CDX Distance Learning**

**Exercise #25**

**Charging System Testing and Diagnosis**

**Student Name:** Click or tap here to enter text.

Click or tap the check box next to the answer choice that best completes the statement or answers the question. Viewing the animations will be required to answer the following question(s) correctly. A diagnostic scenario is presented for each practice session. Review the scenario and then select the animation text to view the charging system. You will use a DMM to measure system voltages at available test points:

* Battery +
* Battery –
* Generator B terminal (red wire)
* Generator ground
* Generator sense signal pin (brown wire)
* Generator field pin (violet wire)
* ECU sense signal (brown wire
* ECU field pin (violet wire)
* ECU ground

Select the correct answer for each part of the charging system testing and diagnosis scenarios. When complete, close the animation window and move on to the next scenario. Scenarios 1 and 2 should be completed in order as step-by-step instructions for using the animation features. Charging system diagnostic tests are presented in each scenario.

[**Charging System Scenario 1**](http://d2jw81rkebrcvk.cloudfront.net/assetscdx2/202003%20-%20COVID/Assessments/MS/ANIM/EE/EE_AltOutTstAss01_C1/EE_AltOutTstAss01_C1/EE_AltOutTstAss01_C1.html)

A four-year-old vehicle was towed into the shop as a no-crank/no-start concern. The technician tested the original equipment battery. It had an open-circuit voltage of 11.4 volts, failed a conductance test for low voltage, and had only a 196 amp capacity for a battery rated at 425 amps. The technician replaced the battery and has asked you to check the charging system to be sure it is okay before completing work on this vehicle.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. The first step is to test the battery’s open-circuit voltage. The ignition is OFF. Select the DMM function dial and use your mouse or track pad to select the DC voltage function. Select and drag each DMM lead to the correct battery post (note that the DMM test lead highlights green when it is in the correct position on the test point). What is the measured battery voltage?   |  |  |  | | --- | --- | --- | |  | a. | 11.4 V | |  | b. | 12.6 V | |  | c. | 12.2 V | |  | d. | 12.4 V | |
| 2. Is this battery voltage okay?   |  |  |  | | --- | --- | --- | |  | a. | No, this indicates a 25% discharged battery | |  | b. | No, this indicates a 50% discharged battery | |  | c. | No, this battery has a surface charge | |  | d. | Yes, this indicates a battery at 100% charge | |

Perform a charging system load test as follows:

* Select the inductive pickup clamp function dial and set it to the amperage function.
* Start the engine using the ignition switch.
* This generator (alternator) is tested at 2200 rpm to a load of 130 amps. Use the throttle slider next to the ignition switch to set the engine to the correct rpm. Be sure to check the generator output specifications before testing. They may be different.
* Use the battery load tester slider to place a load on the generator to the specified maximum amperage.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. Is this charging system okay?   |  |  |  | | --- | --- | --- | |  | a. | Yes | |  | b. | No | |

*This completes scenario 1. Continue to scenario 2.*

[**Charging System Scenario 2**](http://d2jw81rkebrcvk.cloudfront.net/assetscdx2/202003%20-%20COVID/Assessments/MS/ANIM/EE/EE_AltOutTstAss04_C1/EE_AltOutTstAss04_C1/EE_AltOutTstAss04_C1.html) **Guided Practice Session**

The customer states that the charging system warning light is ON and that they have had to call a service to jump-start the vehicle several times in the past few weeks.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. What is the battery’s open-circuit voltage?   |  |  |  | | --- | --- | --- | |  | a. | 11.4 V | |  | b. | 12.6 V | |  | c. | 12.2 V | |  | d. | 12.4 V | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. Is this battery voltage okay?   |  |  |  | | --- | --- | --- | |  | a. | No, this indicates a 25% discharged battery | |  | b. | No, this indicates a 50% discharged battery | |  | c. | No, this battery has a surface charge | |  | d. | Yes, this indicates a battery at 100% charge | |

Perform a charging system load test (*instructions for this are in scenario 1*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. Does this charging system pass the load test?   |  |  |  | | --- | --- | --- | |  | a. | Yes | |  | b. | No | |

If you answered Yes, continue to the next steps to practice charging system diagnostic tests. If you answered No, continue performing charging system diagnostic tests to isolate the cause of the fault.

Perform a voltage drop on the generator B terminal to the battery positive post. This test is done as follows:

* Place the generator under load to its highest amperage.
* Place the DMM positive lead on the B terminal (it is the most positive part of the circuit).
* Place the DMM negative lead on the battery positive post.
* There should be less the 500 mV (0.5 V) drop on this wire.
* Note the DMM reading.

4. Is the B terminal to battery positive voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to practice charging system diagnostic tests. If you answered No, you have isolated the cause of the fault. Since this is a guided practice session, continue and do all the following tests to familiarize yourself with them.

Perform a voltage drop on the generator ground terminal to the battery negative post. This test is done as follows:

* Place the generator under load to its highest amperage.
* Place the DMM positive lead on the battery negative terminal (it is the most negative part of the circuit).
* Place the DMM negative lead on the generator ground.
* There should be less the 200 mV (0.2 V) drop on the ground.
* Note the DMM reading.

5. Is the generator ground to battery negative terminal voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to practice charging system diagnostic tests. If you answered No, you have isolated the cause of the fault. Since this is a guided practice session, continue and do all the following tests to familiarize yourself with them.

6. Is the brown-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered YES, continue to the next steps to practice charging system diagnostic tests. If you answered No, you have isolated the cause of the fault. Since this is a guided practice session, continue and do all the following tests to familiarize yourself with them.

Perform an available voltage test on the generator field wire at the ECU and the generator. This is the brown wire from the ECU to the generator. This circuit provides a generator output voltage signal to the ECU. The normal voltage for this charging system is between 1.5–4.5 volts depending on the battery’s state of charge and charging system load. Perform the test as follows:

* Place the DMM negative lead on battery negative.
* Place the DMM positive lead at the ECU violet wire terminal and note the voltage.
* Place the DMM positive lead at the generator violet wire terminal and note the voltage.
* The readings at each test point should be no more within 50 mV of each other (essentially the same, with no more than a 0.05 V drop).

7. Is the violet-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to practice charging system diagnostic tests. If you answered No, you have isolated the cause of the fault. Since this is a guided practice session, continue and do all the following tests to familiarize yourself with them.

Perform a voltage drop test on the ECU ground. Place the DMM negative lead on the battery negative terminal. Place the DMM positive lead on the ECU ground terminal and then on the ECU ground point. There should be less than a 50 mV drop at either test point. A voltage higher than 50 mV (0.05 V) indicates resistance or an open in the ground circuit that must be corrected.

8. Is the ECU ground-wire voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

9. Based on your test results, what is the charging system fault for scenario 2?

|  |  |  |
| --- | --- | --- |
|  | a. | B terminal to battery positive wire fault |
|  | b. | Generator ground fault |
|  | c. | Generator internal failure |
|  | d. | Violet wire fault—short circuit |

*This completes scenario 2. Continue to scenario 3.*

[**Charging System Scenario 3**](http://d2jw81rkebrcvk.cloudfront.net/assetscdx2/202003%20-%20COVID/Assessments/MS/ANIM/EE/EE_AltOutTstAss35_C1/EE_AltOutTstAss35_C1/EE_AltOutTstAss35_C1.html)

The vehicle was towed in with a dead battery. The battery has been charged and has passed a conductance test and a load test. The customer states that the charging system warning light was ON until the vehicle stalled.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. What is the battery’s open-circuit voltage?   |  |  |  | | --- | --- | --- | |  | a. | 11.4 V | |  | b. | 12.6 V | |  | c. | 12.2 V | |  | d. | 12.4 V | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. Is this battery voltage okay?   |  |  |  | | --- | --- | --- | |  | a. | No, this indicates a 25% discharged battery | |  | b. | No, this indicates a 50% discharged battery | |  | c. | No, this battery has a surface charge | |  | d. | Yes, this indicates a battery at 100% charge | |

Perform a charging system load test (*instructions for this are in scenario 1*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. Does this charging system pass the load test?   |  |  |  | | --- | --- | --- | |  | a. | Yes | |  | b. | No | |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

4. Is the B terminal to battery positive voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

5. Is the generator ground to battery negative terminal voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

6. Is the brown-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

7. Is the violet wire-voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

8. Is the ECU ground-wire voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

9. Based on your test results, what is the charging system fault for scenario 2?

|  |  |  |
| --- | --- | --- |
|  | a. | B terminal to battery positive wire fault |
|  | b. | Brown wire failure |
|  | c. | Generator internal failure |
|  | d. | Violet wire fault—open circuit |

*This completes scenario 3. Continue to scenario 4.*

[**Charging System Scenario 4**](http://d2jw81rkebrcvk.cloudfront.net/assetscdx2/202003%20-%20COVID/Assessments/MS/ANIM/EE/EE_AltOutTstAss07_C1/EE_AltOutTstAss07_C1/EE_AltOutTstAss07_C1.html)

The vehicle was towed in with a dead battery. The customer states that the charging system warning light was ON until the vehicle stalled.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. What is the battery’s open-circuit voltage?   |  |  |  | | --- | --- | --- | |  | a. | 11.4 V | |  | b. | 12.6 V | |  | c. | 12.2 V | |  | d. | 12.4 V | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. Is this battery voltage okay?   |  |  |  | | --- | --- | --- | |  | a. | No, this indicates a 25% discharged battery | |  | b. | No, this indicates a 50% discharged battery | |  | c. | No, this battery has a surface charge | |  | d. | Yes, this indicates a battery at 100% charge | |

Perform a charging system load test (*instructions for this are in scenario 1*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. Does this charging system pass the load test?   |  |  |  | | --- | --- | --- | |  | a. | Yes | |  | b. | No | |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

4. Is the B terminal to battery positive voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

5. Is the generator ground to battery negative terminal voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

6. Is the brown-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

7. Is the violet-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

8. Is the ECU ground-wire voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

9. Based on your test results, what is the charging system fault for scenario 2?

|  |  |  |
| --- | --- | --- |
|  | a. | B terminal to battery positive wire fault |
|  | b. | Generator ground fault |
|  | c. | Generator internal failure |
|  | d. | Violet wire fault—open circuit |

*This completes scenario 4. Continue to scenario 5.*

[**Charging System Scenario 5**](http://d2jw81rkebrcvk.cloudfront.net/assetscdx2/202003%20-%20COVID/Assessments/MS/ANIM/EE/EE_AltOutTstAss05_C1/EE_AltOutTstAss05_C1/EE_AltOutTstAss05_C1.html)

The vehicle was towed in with a dead battery. The customer states that the charging system warning light was ON until the vehicle stalled.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. What is the battery’s open-circuit voltage?   |  |  |  | | --- | --- | --- | |  | a. | 11.4 V | |  | b. | 12.6 V | |  | c. | 12.2 V | |  | d. | 12.4 V | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. Is this battery voltage okay?   |  |  |  | | --- | --- | --- | |  | a. | No, this indicates a 25% discharged battery | |  | b. | No, this indicates a 50% discharged battery | |  | c. | No, this battery has a surface charge | |  | d. | Yes, this indicates a battery at 100% charge | |

Perform a charging system load test (*instructions for this are in scenario 1*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. Does this charging system pass the load test?   |  |  |  | | --- | --- | --- | |  | a. | Yes | |  | b. | No | |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

4. Is the B terminal to battery positive voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

5. Is the generator ground to battery negative terminal voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

6. Is the brown-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

7. Is the violet-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

8. Is the ECU ground-wire voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

9. Based on your test results, what is the charging system fault for scenario 2?

|  |  |  |
| --- | --- | --- |
|  | a. | Internal generator component failure—open diode |
|  | b. | Brown wire fault—short to ground |
|  | c. | Brown wire fault—open circuit |
|  | d. | Violet wire fault—open circuit |

*This completes scenario 5. Continue to scenario 6.*

[**Charging System Scenario 6**](http://d2jw81rkebrcvk.cloudfront.net/assetscdx2/202003%20-%20COVID/Assessments/MS/ANIM/EE/EE_AltOutTstAss25_C1/EE_AltOutTstAss25_C1/EE_AltOutTstAss25_C1.html)

The vehicle has needed a jump-start in the morning after the customer drives it home the night before.

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. What is the battery’s open-circuit voltage?   |  |  |  | | --- | --- | --- | |  | a. | 11.4 V | |  | b. | 12.6 V | |  | c. | 12.2 V | |  | d. | 12.4 V | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. Is this battery voltage okay?   |  |  |  | | --- | --- | --- | |  | a. | No, this indicates a 25% discharged battery | |  | b. | No, this indicates a 50% discharged battery | |  | c. | No, this battery has a surface charge | |  | d. | Yes, this indicates a battery at 100% charge | |

Perform a charging system load test (*instructions for this are in scenario 1*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. Does this charging system pass the load test?   |  |  |  | | --- | --- | --- | |  | a. | Yes | |  | b. | No | |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

4. Is the B terminal to battery positive voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

5. Is the generator ground to battery negative terminal voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

6. Is the brown-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

7. Is the violet-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

8. Is the ECU ground-wire voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

9. Based on your test results, what is the charging system fault for scenario 2?

|  |  |  |
| --- | --- | --- |
|  | a. | Internal generator component failure—open diode |
|  | b. | B terminal to battery positive wire—high resistance |
|  | c. | Brown wire fault—open circuit |
|  | d. | Violet wire fault—open circuit |

*This completes scenario 6. Continue to scenario 7.*

[**Charging System Scenario 7**](http://d2jw81rkebrcvk.cloudfront.net/assetscdx2/202003%20-%20COVID/Assessments/MS/ANIM/EE/EE_AltOutTstAss08_C1/EE_AltOutTstAss08_C1/EE_AltOutTstAss08_C1.html)

The vehicle has needed a jump-start in the morning after the customer drives it home the night before.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. What is the battery’s open-circuit voltage?   |  |  |  |  | | --- | --- | --- | --- | |  | a. | 11.4 V |  | |  | b. | 12.6 V |  | |  | c. | 12.2 V |  | |  | d. | 12.4 V |  | |

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2. Is this battery voltage okay?   |  |  |  | | --- | --- | --- | |  | a. | No, this indicates a 25% discharged battery | |  | b. | No, this indicates a 50% discharged battery | |  | c. | No, this battery has a surface charge | |  | d. | Yes, this indicates a battery at 100% charge | |

Perform a charging system load test (*instructions for this are in scenario 1*)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 3. Does this charging system pass the load test?   |  |  |  | | --- | --- | --- | |  | a. | Yes | |  | b. | No | |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

4. Is the B terminal to battery positive voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

5. Is the generator ground to battery negative terminal voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

6. Is the brown-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

7. Is the violet-wire voltage within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

If you answered Yes, continue to the next steps to continue the charging system diagnostic tests. If you answered No, go to question 7.

8. Is the ECU ground-wire voltage drop within specifications?

|  |  |  |
| --- | --- | --- |
|  | a. | Yes |
|  | b. | No |

9. Based on your test results, what is the charging system fault for scenario 2?

|  |  |  |
| --- | --- | --- |
|  | a. | Internal generator component failure—open diode |
|  | b. | B terminal to battery positive wire—high resistance |
|  | c. | Brown wire fault—open circuit |
|  | d. | Violet wire fault—open circuit |

This completes the charging system testing and diagnosis practice sessions. Review your results with your supervisor/instructor. Ask questions to clarify your understanding, if required. Thank you for participating in CDX Automotive Technician Education.